A Location Tracking by RFID to Assist the Transportation Vulnerable in Subway Stations

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Abstract: - This work has the objective of creating an information service to supply necessary information to mobility handicapped individuals based on a monitoring technique. There are a number of stumbling blocks in a subway station in the routing of infrared rays, supersonic waves, or generic RF signals. In this work we used a space digitization method than triangulation methods using RF signals. We suggest an alternative location positioning method that makes use of a mosaic map. A number of RFIDs are implanted instead of sensors, which are not expensive solution for public facilities.

Key-Words: - Location Positioning, Radio Frequency Identification, Transportation Vulnerable, Mosaic Map, Triangulation.

1 Introduction
Korea is a nation moving fastest toward advanced age society (Aged Society, 14 ~ 20%) from aging society (Aging Society, 7 ~ 14%), as indicated by UN's old age population standard (persons more than 65 years old). However, according to Traffic Development Institute's "Traffic service welfare improvement way for disabled person, old and the weak" research in 2004, improvement effect that a transportation vulnerable realize appears by feeble thing up to now. A transportation vulnerable in the subway is defined as following;

One has transportation restrictive disorder but use a crutch such as a stick or wheel chair and so on, and is able to move, but uncomfortably, solely in transportation.

In addition, people who have eyesight trouble that causes difficulty in getting geographical information (toilet, transfer junction, way-out path etc.) are included in the transportation vulnerable classification.

Basically, to provide directional information and assistance, monitoring is required for the transportation vulnerable that is moving through stations. This work has the objective of creating an information service to supply necessary information to mobility handicapped individuals based on a monitoring technique. There are various location positioning techniques but when considered environment in stations, it is hard to apply current naive techniques. The sensitivity of sensors, whether they are supersonic wave, IR, laser, or etc., declines with vibration and station noise, together with the obstruction and impact of the environment from the complexity of the structure. In this environment an alternative method suggested in this paper is to exploit a digitized space with locating by RFID. This work describes about various location positioning techniques and derived applicable technique for subway stations. We would conduct a location positioning experiment in some environment using the alternative method that made use of a mosaic map. This method would be appropriate for the environments with obstacles (structure, moving people, etc.), the subway stations for example.

2 Location Positioning
Figure 1 depicts the conceptual design of a monitoring system in the case built on the wireless sensor network. The nodes are linked ad-hoc and linked to the monitoring server. Also, an installed directional antenna is used to capture directional information for the person, which is important when offering facility information. Basically, the present position information is transmitted and the person receives facility information through the monitoring system.
Monitoring resolution is determined by the gaps between the installed nodes and the person’s position information is transmitted in real time.

Figure 1 Operating Scheme on WSN

There are various other positioning technologies that use various sensors, including infrared, supersonic wave, and RF signals. These technologies are utilized according to their respective characteristics, their merits and demerits. A representative system that makes use of infrared rays is Active Badge [1, 2], and those that make use of supersonic waves include Active Bat [3], and Cricket [4, 5].

There are ways to exploit the intensity or propagation delay of the RF signal from a wireless LAN’s access point with RADAR [6] but there is a difficulty in the miniaturization of devices with wireless LAN support. Besides, there are a number of stumbling blocks in a subway station in the routing of infrared rays, supersonic waves, or generic RF signals. The route can become different by the diffraction or reflection of a signal by obstacles. Thus in this work we used a space digitization method than triangulation methods using RF signals.

2.1 Mosaic map

Figure 2 Operating Scheme with a RFID reader and RFIDs

Figure 2 depicts the conceptual design of a monitoring system composed with a RFID reader and RFIDs. On the paths the RFIDs are implanted in a regular pattern. The transportation vulnerable is moving with a location tracking device with an RFID reader. When the reader detects the next RFID tag, it is transmitted to the monitoring server and recorded in the server. By recording the sequence of RFID tags, the track of the transportation vulnerable is made up and the person’s location is monitored in real time.

The implantation pattern of RFIDs is important in determining the direction the person is moving. The rectangular pattern of Figure 3 doesn’t digitize the space efficiently. We call this digitized space a mosaic map. Figure 3 shows the sexangular pattern constituted by tag cells, and RFIDs are implanted at the center of each sexangles. In the case the mobile point moves through a borderline, the direction of the MP is in the middle of the two tag cells. It is determined the MP is going to west in the upper side of Figure 3.

2.2 Higher resolution

Some areas such as platforms are not safe enough to easily pass through. For the safety of the transportation vulnerable, smaller sexangles of tag cells are placed in those areas. As RFIDs are implanted closer the RFID reader detects multiple tags at nearly same time. For the tags detected continually within a predetermined
duration, they are recognized as nearby tag cells, but in the proximity order by the sequence they detected.

3 Experimentation

In the Figure 2, the mobile point is a transportation vulnerable to be tracked and each fixed point is a RFID implanted in the station. The MP transmits a tag value as it detects the next RFID. The direction is determined and the velocity is calculated, and thus the approximate location on or near tag cell is processed in the monitoring server. The coordinates of each FP and the MP are on the absolute coordinate system. According to the application composition, the position information could be delivered to the other monitoring site for continued monitoring from the site.

The experimentation site is an office of about 472m² and absolute coordinates are established based on the plan figure. Each FP is allocated unique ID and arranged in the room. Figure 4 displays the composition of the experimental setup.

![Figure 4 Composition of the experiment setup](image)

In the experiment, the positioning was adequately correct. Approximate locations are processed without any incursions of the obstacles as we expected. It is very different from the other positioning techniques using RF signals reactive to the directivity of antenna or any obstacle. As the MP is moving a device with an RFID reader, we anticipate, the devices might be capable of group communication to relay the transmission of a device in the situation its transmission is not reached to the access point including malfunction of the closest access point.

4 Conclusion

A number of RFIDs are implanted instead of sensors, which are not expensive solution for public facilities. The suggested method is well suited to most of buildings, for the transportation vulnerable. While they pass through paths their passages are monitored and could be cared. The suggested method does not suffer from energy shortage suchlike in wireless sensor networks. The method should provide practical assistance to the transportation vulnerable.

References:


